



ECOWAS MASTER PLAN FOR THE DEVELOPMENT OF REGIONAL POWER GENERATION AND TRANSMISSION INFRASTRUCTURE 2019-2033

Final Report

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TRACTEBEL ENGINEERING S.A.

Boulevard Simón Bolívar 34-36
1000 - Brussels - BELGIUM
tel. +32 2 773 99 11 - fax +32 2 773 99 00
engineering@tractebel.engie.com
tractebel-engie.com

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03	2019 01 17	FIN	*L. Charlier *L. Bouzat	*J. Dubois	*J. Dubois	
02	2018 12 12	FIN	*L. Charlier	*J. Dubois	*J. Dubois	
00	2018 10 01	FIN	*L. Bouzat	*J. Dubois	*J. Dubois	
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TRACTEBEL ENGINEERING S.A. - Registered office: Boulevard Simón Bolívar 34-36, 1000 Brussels - BELGIUM

VAT: BE 0412 639 681 - RPM/RPR Brussels: 0412 639 681 - Bank account IBAN: BE74375100843707 - BIC/SWIFT: BBRUBEBB

Synthesis

INTRODUCTION

The collective vision of the Economic Community of West African States (ECOWAS) is to develop the West African Power Pool (WAPP) – a cooperative power pooling mechanism for integrating national power system operations into a unified regional electricity market – with the expectation that such mechanism would, over the medium to long term, assure their citizens a stable and reliable electricity supply at affordable costs. In 2012, the Authority of the ECOWAS Heads of State and Government approved, through Supplementary Act A/SA.12/02/12, a list of 59 Priority Projects for the subregion that emanated from the update of the ECOWAS Revised Master Plan for the Generation and Transmission of Electrical Energy prepared by Tractebel.

However, in view of, among others, the evolution of the energy landscape in West Africa over the last five years, the renewed drive of the sub-region to better integrate variable renewable energy resources into the energy mix, Initiatives aimed at addressing energy challenges in the sub-region such as the West Africa Clean Energy Corridor (WACEC), the near-term commissioning of the WAPP Information and Coordination Center (ICC) as well as the operationalization of the regional electricity market within the ECOWAS region, an update of the 2012 Master Plan is required.

In this context, the present study aims at formulating a new **ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure 2019-2033**, that shall provide a rational basis for decision-making and investment in the power sector at the regional level.

It is important to highlight the excellent collaboration and assistance provided by the Energy Directorate of the ECOWAS Commission, the General Secretariat of the WAPP, UEMOA Commission, the WAPP Member Utilities, the Ministries in charge of energy in the concerned ECOWAS Member States, the sub-regional organizations involved in the electricity sub-sector as well as international organizations such as IRENA. The exchanges and the information gathering process have also been greatly facilitated by the active and effective participation of the WAPP Secretariat.

CHALLENGES FOR THE WEST-AFRICAN POWER SYSTEM

The West African energy sector is currently evolving at a significant rate, creating many challenges for the planning and operation of the system and representing many opportunities for an energy transition in West Africa.

A high growth of electrical demand

With an average annual forecasted growth rate of more than 8% for the next 15 years according to the load forecast prepared within the framework of this study, the ECOWAS region ranks high among regions with high growth around the world. In order to meet this demand, the sub-region can rely on the abundant resources available locally such as:

- Invaluable solar potential, particularly in the part of the sub-region (Mali, Burkina Faso, Niger);
- Untapped hydropower potential, mainly in Guinea, Côte d'Ivoire, Nigeria, Sierra Leone and Liberia (estimated potential of about 11 GW)
- Proven gas resources in Nigeria, Côte d'Ivoire, Ghana and Senegal

The implementation of the ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure 2019-2033 shall contribute significantly to the satisfaction of the entire demand of the sub-region by optimally developing the available resources within the ECOWAS Member States.

An interconnected network in its infancy stage

While the power system of most of the 14 mainland countries of ECOWAS¹ were still isolated 15 years ago, the last decade has been marked by the commissioning of many interconnections and others are still under construction. The commissioning within the next 2 years of the CLSG line and the OMVG loop will lead to the interconnection of the 14 mainland countries of the subregion.

The interconnected network of the WAPP offers a multitude of opportunities for the exchange of electricity. However, the operation of such a network creates new challenges for the network operators. The stable functioning of the entire interconnected system remains a major issue for years to come. The list of priority projects to be developed in the next 3 to 4 years must therefore aim to address this operational challenge.

The need to develop a subregional electricity market

In the context of an interconnected power system, the operationalization of the Electricity Market launched in June 2018 will become all the more important as countries shall be ready to exchange energy with available generation capacity (in particular renewable but also hydropower and thermal).

¹ ECOWAS has fifteen (15#) Member States that are Benin, Burkina, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

In parallel, the operationalization of the WAPP Information and Coordination Centre (ICC) which shall play the role of market operator, shall ensure among others, transparency and market neutrality due to the sharing of data and information, the maintenance of an up-to-date model of the interconnected power system, the enforcement of common operating rules, the harmonization of protection schemes, and the calculation of Net Transfer Capacity among the involved countries.

The presence of critical factors affecting the performance of power Utilities

The exchanges and feedback gathered from the players in the electricity sub-sector allowed the identification of cross-cutting critical factors that are affecting the performance of WAPP member utilities. These factors were grouped into six main areas that were related to governance, planning, major project development, operational efficiency, financial health, business efficiency and skills development. The review of the actions plans implemented by some of the electricity utilities in the region as well as the analysis of the measures envisaged in other regions of the world facing similar problems have made it possible to propose a series of recommendations to deal with the critical factors identified.

These action plans must be implemented within the power utilities and these include the strengthening, planning and extension of national transmission and distribution networks as well as the implementation of prepaid metering systems to improve performance on revenue collection. Other improvements are nevertheless to be implemented at the level of the sectorial organization, such as the need to strengthen the regulatory authority and its prerogatives on the electricity tariff.

Lastly, the WAPP and the other specialized institutions/agencies of ECOWAS can also carry out some measures aimed at facilitating the implementation of transverse corrective actions and these could include the sharing of knowledge and lessons learnt, coordination between national development plans and regional ambitions, development of framework and reference documents, promotion of regional projects, skills transfer and capacity reinforcement of stakeholders.

REGIONAL MASTER PLAN

Given the current situation of the electricity sub-sector and the issues identified for its future development, the generation and transmission master plan has been developed to meet three main objectives:

- **The optimal integration of the variable renewable energie resources** in West Africa, taking into account economic, environmental and technical constraints;
- **The development of infrastructure** (transmission and generation) necessary to operationalize the electricity market in West Africa;
- The need to **guarantee security of supply** in the short, medium and long-term, taking into account the *Needs* in terms of electrical energy and *Constraints* related to the generation (especially variable renewable) and the transmission (sometimes over long distances) of electricity.

The resulting generation and transmission master plan was thus compiled. Given the different issues facing the sector in the short, medium and long term, the master plan has been divided into these three intermediate phases:

Short-term issues (2019 – 2022)

The electric demand for ECOWAS of 15.3 GW in 2018 should evolve towards 21.3 GW in 2022. Such growth requires the massive development of generation and transmission infrastructure.

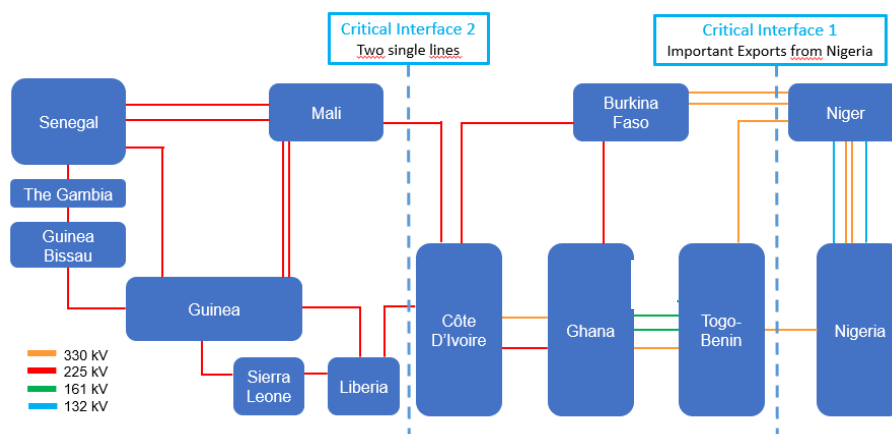
From a power generation point of view, the major short-term issue is the adherence to the Schedule for the implementation of the decided projects.

In order to succeed in this transition, the development of solar projects in all the countries of the sub-region will have to be supported by a regulatory framework and appropriate financial measures. In addition, the role of battery storage to support the development of variable renewable energy is being studied by the WAPP in a dedicated study.

In addition, the fossil fuels will remain the most important resource for electricity generation over the next five years. Therefore, the availability of natural gas will continue to play a crucial role in ensuring the viability of the master plan. The reliability of gas supply in particular through the diversification of primary sources is therefore one of the major challenges for the sub-region.

From the point of view of transmission, beyond the challenge associated with the implementation schedule, there is an operational challenge to ensure the stable and coordinated operation of the entire WAPP interconnected system. Two sections appear to be critical

- The connection of Niger-Nigeria with the rest of WAPP;
- The connection between Western ECOWAS Member States (Senegal, Mali, Guinea, Guinea-Bissau, The Gambia, Sierra Leone and Liberia) with the rest of WAPP.



Presentation of critical interfaces

The investment plan must therefore ensure that these two Interfaces include a minimum of 3 interconnection lines in order to guarantee the stability of the system. It is worthy to note that:

- For the critical interface 1, the implementation of the 330 kV North Core, the Median Backbone (in the mid-term) and the strengthening of the 330 kV Nigeria-Benin axis thus appears as a priority.
- For the critical interface 2, the implementation of the 2nd circuit of the 225 kV CLSG interconnection project and the acceleration of the 330 kV Ghana-Burkina-Mali interconnection project, in particular the Bobo-Sikasso segment, are essential.

It is also necessary to expand the measures defined in the WAPP Synchronization Study by strengthening the capacities of the Static Var Compensators (SVCs) in Niger and Burkina and by setting the Power System Stabilizer (PSS) of key generation units located at the endpoints of the system to stabilize an interzonal oscillation mode (frequency 0.27 Hz) in the system.

Finally, it is recommended to develop special protection schemes (SPS) to ensure the safety of the system in the event of an incident. In broad terms, an update of the WAPP Operations Manual and a harmonization of the protection schemes (UFLS, interconnection protections,...) is recommended.

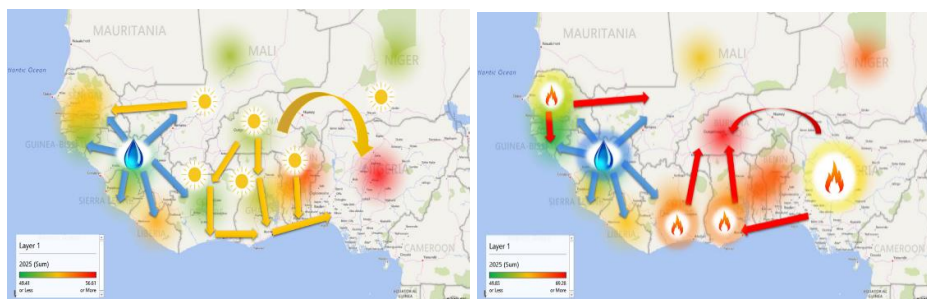
Medium-term issues (2023 – 2029)

At mid-term, the load demand should continue growing, evolving from 21.3 GW in 2022, to 26.8 GW in 2025 and 36.4 GW in 2029.

This period will be characterized by a significant increase in the share of renewable energy in the energy mix of the subregion.

Therefore, in 2029, 38% of the electricity produced throughout the West African region will come from renewable energy technologies, including 24% hydropower, 13% solar photovoltaic and 1% wind power.

Massive investments in renewable energy over the medium term will reduce the marginal costs for the whole region. However, as the solar potential is mainly located in the North of the sub-region, the optimal use of regional resources requires the development of interconnections and battery storage capacity so that each ECOWAS Member State can benefit all day from the best resources available.



Distribution of average marginal costs in the region at 12 AM (left) and 9 PM (right) in 2025

One of the challenges to address in the mid-term horizon is the lack of a strong interconnected network to ensure synergy between hydropower resources, gas and solar.

Thus, in addition to the installation of the 2nd circuit on the 225 kV CLSG Interconnection project and the commissioning of the 330 kV Ghana-Burkina-Mali interconnection, project that have already been identified as essential in the short-term to ensure the stability of the system, the main needs in terms of strengthening interconnections include:

- The construction of the 330kV median backbone among Nigeria, Benin, Togo, Ghana and Côte d'Ivoire to address among others, the increase of Nigeria's import-export capacity through;
- The development of the 225 kV OMVS transmission line from Mali to Guinea and the new 225 kV interconnection between Guinea (Fomi) and Côte d'Ivoire (Boundiali);
- The 225 kV Liberia-Côte d'Ivoire Interconnection (Buchanan - San Pedro) to coincide with the commissioning of the Tiboto hydropower site.

Long-term issues (2030 and beyond)

The long-term period considered in this study covers the years 2030 to 2033. Over this long-term interval, demand continues to grow exponentially in the region, as the synchronous peak demand of the region is foreseen to evolve from 36.4 GW in 2029 to 50.8 GW in 2033.

During this period, and in light of the integration rate of variable renewable energy projects, one of the main issues lies in the satisfaction of the reliability criteria and the generation support to maintain flexibility in the interconnected system. As a result, additional investments must be made in thermal units mainly from 2030.

However, battery storage will have to play a major role in improving flexibility and increasing the security of supply in the subregion, not only in the long-term, but also in the mid- and short-terms. Considering the expected evolution in the cost of storage technologies, batteries could complement some of the investments in gas turbines during the study period, support frequency and voltage control in the network, and facilitate the further deployment of variable renewable energy projects.

At the transmission level, some major interconnection projects are recommended during this period. These new interconnections will allow for increasing transfer capacities between Nigeria and the rest of WAPP but also participate in the reliability of the system by allowing mutual support throughout the ECOWAS region. These interconnection projects also envisage interconnections of the WAPP with other regions beyond its current boundaries.

PRIORITY REGIONAL INVESTMENT PROGRAM

Priority Regional Projects

In addition to the decided projects, the priority list of regional generation and transmission projects have been recommended on the basis of the following criteria:

- A minimum size of 150 MW;
- A major role in the sustainable development of the sub-region
- A regional vocation (location, sharing of energy between border countries, importance at regional level)

On this basis, the proposed list of regional priority projects under the ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure 2019 – 2033 shall be characterized by the following:

- **75 (#) regional projects**, deemed priority, with an estimated total investment cost of US\$36.39 billion, of these,
 - **28 (#) Transmission line** projects of approximately 22,932 km of high-voltage transmission lines at an estimated cost of US\$10.48 billion;
 - **47 (#) generation projects** with a total capacity of approximately 15.49 GW at an estimated cost of US\$25.91 billion;
- Given that the WAPP, in the short term, shall achieve the power system integration of the 14 mainland ECOWAS Member States, the priority list also contains transmission line projects that shall enable WAPP interconnect beyond its current area of coverage in order to among others, further economically diversify its energy mix. These include the northern part of Africa through Morocco and the Central African Power Pool to Inga.
- The generation projects comprise:
 - 31.1% thermal projects operating mainly with natural gas and
 - 68.9% renewable energy projects (10.67 GW) of which 29.5% involve Variable Renewable Energy (VRE) projects (3.15 GW solar, wind);
- VRE projects constitute 20.33 % of the total generation in the priority list.

All of these projects contribute in one way or the other towards the sustainable development of the ECOWAS sub-region, the further development of the regional electricity market and/or the improvement of security of supply in West Africa. There are therefore of paramount importance for the sub-region and their implementation, even though a challenge, shall allow for the optimal development of the WAPP interconnected system. The list of regional priority projects is as indicated in Annex and the map also in Annex illustrates their approximate localisation

With regards to the realization of these priority projects, it should be noted that historically, the public sector were entirely responsible for the development of capital-intensive and strategic power generation and transmission projects. Nevertheless, the current budgetary constraints of ECOWAS Member States coupled with the high investment requirements for the development of energy projects have given rise to alternate modes of structuring projects involving the private sector. Depending on the solution chosen, the latter can bear a greater or lesser responsibility for the realization of the projects. This mode of project development is called "Public Private Partnership (PPP)".

International experience of this type of project developement shows that private sector participation generally brings benefits in relation to the implementation of projects with public interest. The private partner brings proven experience in the design, development and construction of major projects in the electricity sector. The partner shall also have more experience and incentives for EPC contracts to be signed and implemented effectively, thereby maximizing project interest. All these lead to potentially obtaining the best price for projects as well as possibly achieveing commissioning dates according to planned schedules. In addition, private sector participation, with the experience, organization and financial discipline that it brings, generally ensures adequate project operation and maintenance and therefore ensures sustainability

The implementation strategy for each of the recommended priority projects shall have to take into account among others, the intrinsic characteristics of these projects, the technologies concerned and the number of partners (or Member States) concerned.

Solar and wind renewable energy projects represent particularly interesting opportunities to favor the participation of the private sector. The development of these types of projects by the private sector could be systematically done through Auctions that could involve different development schemes such as the "plug-and-play" scheme. Such schemes generally tend to reduce the risks for private investors with regards to construction and power evacuation.

Large thermal generation projects represent also opportunities to attract private partners to take charge of the project development, following the example of the regional Maria Gleta project. Key success factors of this approach reside in securing the fuel supply, whose responsibility can be transferred to the private partner, and in obtaining electricity purchase commitments from the relevant States, for which a strong regional coordination is required.

Where the public sector has to continue to be involved in the implementation of projects, such as cross-border interconnection projects, it is strongly recommended an institutional framework reflecting the joint implementation of projects continue to be pursued. The WAPP has already employed variations of this strategy in some of its existing projects such as the 225 kV CLSG Project, the 330 kV Northcore Project as well as the 225 kV Ghana – Burkina Interconnection Project.

Exchange opportunities beyond the WAPP area

Given that the WAPP, in the short term, shall achieve the power system integration of the 14 mainland ECOWAS Member States, it makes sense that the WAPP takes steps during the period covered by the study to further economically diversify its energy mix. A plausible course of action in this regard is to interconnect beyond its current area of coverage.

Interconnection with the Northern part of Africa

In order to link the WAPP system to the Northern Africa and European power systems through Morocco, different interconnection options have been analyzed and compared from a techno-economic point of view. On the basis of preliminary analyses, the option of a HVDC–VSC with line route from Tobene (Senegal) to Dakhla (Morocco) is recommended.

The preliminary economic analysis, for its part, has determined that there is an economic interest in interconnecting WAPP and North Africa. The WAPP system will benefit from a reduction in installed capacity requirements and operational costs due to imports from Morocco and probably from North Africa as well as Europe.

Interconnection with the Central African Power Pool

From an economic point of view, there is an interest in interconnecting the WAPP network with the Central African Power Pool (CAPP) to not only access the abundant and low-cost power from Inga but also from other hydropower sites in the CAPP region. Also, beyond the cost savings to be realized in terms of operational costs, the interconnection shall also result in economies in terms of investment costs, since this interconnection shall displace the need for additional thermal units, which would have been needed in the reference case for reliability.

Connection Opportunities with Cape Verde

The interconnection of Cape Verde with WAPP is technically feasible through an HVDC cable to connect Praia (Cape Verde) and Dakar (Senegal), a distance of about 650 km. This interconnection could benefit the sub-region in ways that include the sharing of the solar and wind resources of the archipelago as well as the improvement of the security of supply for Cape Verde. Given the level of demand currently on the archipelago (less than 100 MW) and in light of the exchanges that could take place, the implementation of HVDC cables seems prohibitive. A precondition for the interconnection with the mainland, is the linking of the islands that shall not only improve the security of supply but shall also deploy more optimally the numerous renewable energy projects and reduce cost.

Priority Action Plan for WAPP

In addition to the development of the 75 Priority projects, the major actions to be undertaken by the WAPP for an efficient implementation of the Master plan as well as an optimal operation of the interconnected system include:

Support to the development of renewable energy projects

In addition to the optimum leveraging of hydropower resources through the development of priority projects, the economic analyses carried out conclude that by 2033, the development of the proposed variable renewable energy projects (solar PV and to a lesser extent wind turbine) shall constitute 18% of energy produced on the basis of renewable resources (excluding hydro) within the sub-region.

In particular, the dynamic studies carried out for the years 2022 and 2025 considered an instantaneous integration rate at the solar peak of respectively 17% in 2022 and 28% in 2025. For this rate, the studies demonstrated the technical feasibility of the integration of intermittent renewable energy while optimizing the operation of the system. Thus, the techno-economic feasibility integrating intermittent renewable energy has been demonstrated for a total of 3.3 GW by 2022, 7.0 GW by 2025, 9.6 GW by 2029 and 12.1 GW by 2033.

Of these intermittent renewable projects, 15 solar, wind and hybrid projects were included in the list of priority projects for a total of 3.15 GW

In addition, an economic potential for a total of 37.5 GW by 2033 (ie 24.9 GW in addition to the 12.1 GW previously presented) has been identified. This economic potential, in order to be developed, will nevertheless have to be the subject of in-depth studies, particularly from a technical point of view.

As such, the WAPP shall have to play an important role as a driving force by accompanying the countries in their energy transition through among others the shared experience for the contract arrangement of generation agreements, the support to the development of in-depth network studies in the different Member States, and the securing of adequate funding sources for the preparation and implementation of the projects.

The availability of the necessary skills should also be ensured by supporting a capacity building program in areas that include operations and planning management.

In addition, it is recommended that the WAPP pursue other opportunities related to renewable energy deployment such as the hybridization of hydropower and thermal power plants, the development of floating photovoltaic technologies and the deployment of storage technologies (including battery), and to subsequently implement the related projects for which the economic viability have been demonstrated.

Monitoring the development of projects carried out by other regional entities

By their mandate, a number of sub-regional entities (such as OMVS, OMVG, CEB, NBA, MRU) have the responsibility to develop generation and interconnection infrastructure that shall benefit their respective Member States. Sometimes it is a multi-purpose infrastructure but for which the generation or transmission of electricity play an important role. Given their regional impact, these generation (especially renewable and hydropower) and transmission projects should be closely monitored by the WAPP independent of their size.

Support to the optimal operation of the interconnected network

In order to ensure the optimal and coordinated operation of the interconnected network and thus successfully synchronize the electrical networks of the 14 mainland ECOWAS Member States, the WAPP and its Member Utilities shall have to undertake actions that include:

Recommendation	Approximative cost of the measure
Tune PSS of some large units at the extremities of the WAPP system to improve the damping of a critical 0.27 Hz interarea mode between eastern WAPP and the rest of WAPP	500kUSD ²
Update the WAPP Operations Manual	300 kUSD
Set up a Special Protection Scheme (SPS) to increase trade between Nigeria and the rest of the WAPP	2 MUSD
Improve dynamic voltage compensation by adding one SVC at Ouagadougou (Burkina) and one at Salkadamna (Niger)	30 MUSD
Operationalize the WAPP Information and Coordination Centre (CIC)	

It is strongly urged that the 330 kV Ghana – Burkina – Mali Interconnection Project (approximately US\$234 million) as well as the 2nd Circuit of the CLSG Project (approximately US\$131 million) be implemented soonest as they shall both contribute towards the optimal operation of the interconnected system.

Implementation of action plans to improve the performance of WAPP member utilities

Based on the best practices observed in the WAPP member utilities as well as in other regions of the world facing with similar issues, a list of actions has been proposed that aim at improving the performance, the efficiency and the sustainability of WAPP member utilities.

² Source : synchronisation study

Depending on the context of each country and each utility, the sequence in which the actions are implemented may vary. Nevertheless, in view of the cross-cutting nature of the critical factors affecting the performance of utilities within the region, the following priority actions can be proposed:

Theme	Main priority actions to implement at utility level
Governance	Adequate use of plan contracts, performance contracts and management contracts taking advantage of the lessons learned from utilities having experienced them.
Planning	Pursuit of the consistency between national masterplans and the ambitions reflected in the regional masterplan. Extension and reinforcement of national networks and interconnections as a key factor for system performance.
Development of large projects	Diversification of development modes and increased involvement of the private sector.
Commercial efficiency	Support to cross-border electricity exchanges by standardizing contractual clauses of electricity import and export, with the support of ERERA. Implementation of clientele management systems and of call centers. Implementation of pre-paid metering systems and decentralization of invoicing and payment collection activities.
Capacity development	Reinforcement of human resources in technical, legal, financing, commercial and procurement areas in collaboration with Development Finance Institutions, strengthening of WAPP Centers of Excellence and creation of partnerships with universities in the sub-region.

Action Plan to promote the diligent implementation of projects

A diagnosis of the implementation of the priority projects from the 2012 – 2025 regional masterplan has been conducted through the collection of lessons learned by the actors involved in these projects. This approach highlighted recurrent delaying factors for the development of projects and for the compliance to the schedule established in the previous masterplan.

Based on this diagnosis, an implementation strategy has been established for the updated regional masterplan with the objective of reducing the duration of project development. The proposed actions are the following:

Actions to promote the diligent implementation of projects

Further deployment of institutional frameworks that reflect the common implementation of regional projects such as the creation of Special Purpose Companies (e.g. Transco CLSG) or Joint Project Management Units (e.g. Northcore, OMVG Loop).

Identification of new sources of financing for the implementation of environmental and social mitigation measures from Development Finance Institutions and possibly, pre-financing by the private sector.

Reinforcement of the WAPP to ensure a coordination between national planning and the ambitions of the regional masterplan, in particular through the development of a reference planning software for the region.

Scaling-up of private sector participation in the development of regional variable renewable energy projects. This could include, among others, the development of large renewable energy (solar and wind) priority projects through Auctions involving « plug-and-play » scheme.

Reinforcement of the WAPP to extend its coordination and information sharing activities beyond the Member utilities and the WAPP Technical and Financial Partners to reach other Actors within the sub-sector such as National Regulators, Manufacturing and Industry, other high-level government entities involved in the electricity sub-sector, and other financing institutions (national export-import banks, investment funds, etc).

Advocating increased coordination among the Development Finance Institutions (DFIs) supporting regional projects, in particular regarding the harmonization of procurement guidelines for regional projects, the harmonization of disbursement conditions where various DFIs are involved in the same project and the coordination with export-import banks active in the projects' countries.

Enhancing funding for project pre-investment studies including the rapid operationalization of the FODETE to fund project preparation activities.

Granting of land with free-zone status at appropriate target locations by countries that have been identified to host the regional solar and/or wind power parks

Diversification of financing resources for the realization of the priority projects that could include Green Climate Fund and enhanced private sector participation

Setting-up of rewarding and strategic partnerships that are fully aligned with the priorities of the Region and shall, among others, facilitate the implementation of the Master Plan

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APPENDIX

Priority Generation Projects

	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
ShortTerm	*Gouina Hydropower plant (OMVS)	140	462	2020
	*Souapiti Hydropower plant In Guinea	450	1350	2020
	*Gribo-Popoli Hydropower plant in Côte d'Ivoire	112	345	2021
	*Sambangalou Hydropower plant (OMVG)	128	454	2022
	*Zungeru Hydropower plant in Nigeria	700	1200	2022
	*Fomi Hydropower plant in Guinea	90	620	2022
	*Wind Farm in Senegal	150	230	2019-2021
	*Azito IV Thermal Power Plant CC in Côte d'Ivoire	253	302	2020
	*Ciprel V Thermal Power Plant CC in Côte d'Ivoire	412	505	2021
	*Early POWER Thermal Power Plant CC in Ghana	300	390	2019
	*GPGC Thermal Power Plant CC in Ghana	170	221	2019
	*Amandi Thermal Power Plant CC in Ghana	240	312	2019
	*Rotan Thermal Power Plant CC in Ghana	330	429	2022
	*KADUNA Thermal Power Plant in Nigeria	215	280	2019
	*OKPAI Thermal Power Plant in Nigeria	450	585	2020
	*SALKADAMNA Thermal (Coal) Power Plant in Niger	200	573	2021
	Maria Gleta Thermal Power Plant in Benin	450	585	2022 recommended for the first GT
	Boutoubre Hydropower plant in Côte d'Ivoire	150	343	2022 recommended (1 st group)
	TOTAL SHORT-TERM	4940 MW	9185 MUSD	

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	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
Mid-term	*Amaria Hydropower plant in Guinea	300	600	2023
	*Bumbuna II Hydropower plant in Sierra Leone	143	358	2023
	*Louga Hydropower plant in Côte d'Ivoire	246	647	2023
	*Koukoutamba Hydropower plant (OMVS)	294	689	2024
	*Mambilla Hydropower plant in Nigeria	3050	5800	2024
	*Adjaralla Hydropower plant (Togo-Benin)	147	333	2026
	*Tiboto Hydropower plant (Côte d'Ivoire-Liberia)	225	599	2028
	*Alaoji II Thermal Power Plant in Nigeria	285	371	2025
	*San Pedro Thermal (coal) Power Plant in Côte d'Ivoire	700	1900	2026-2029
	Solar Farm PV in Burkina Faso	150	139	2022-2024 Recommended
	Solar Farm PV in Mali	150	139	2022-2024 Recommended
	Solar Farm PV in Côte d'Ivoire	150	143	2022-2024 Recommended
	Solar Farm PV in The Gambia	150	130	2023-2025 Recommended
	Solar Farm PV in Benin	150	120	2024-2026 Recommended
	Solar Farm PV in Nigeria	1000	695	2025-2029 Recommended
	Solar Farm PV in Ghana	150	108	2026-2027 Recommended
	Solar Farm PV in Togo	150	90	2028-2030 Recommended
	Grand Kinkon Hydropower plant in Guinea	291	350	2023 Recommended
	Morisananko in Guinea (Hybrid PV – Hydro)	200	353	2025 Recommended
	Bonkon Diara Hydropower plant in Guinea	174	211	2025 Recommended
	Boureya Hydropower plant (OMVS)	114	448	2029 Recommended

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Aboadze II Thermal Power Plant in in Ghana	450	585	2029 Recommended
TOTAL MID-TERM	8669 MW	14808 MUSD	

	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
Long-term	Solar Farm PV in Niger	150	90	2030 Recommended
	Solar Farm PV in Burkina (Phase II)	150	84	2031 Recommended
	Solar Farm PV in Mali (Phase II)	150	77	2032 Recommended
	Wind Farm in Nigeria	300	190	2030 Recommended
	Mano Hydropower plant (MRU)	180	487	2030 Recommended
	Songon Thermal power plant in Côte d'Ivoire	369	480	2031 Recommended
	Saint Paul Reservoir In Liberia	1 st phase: Via Reservoir 2 nd phase : New project 360 MW to 585MW	511 (for the first phase)	1 st phase: 2025 Recommended 2 nd phase : 2030
	TOTAL LONG-TERM	1883 MW	1919 MUSD	
	GRAND TOTAL	13592 MW	25912 MUSD	

* Decided Project

Priority Transmission Projects

	Line	Level Voltage KV	Length [km]	Estimated cost [MUSD]	Date of commissioning
Short-term	*Coastal backbone project: interconnection Volta (Ghana) - Lomé (Togo) - Sakété (Benin)	330	340	122	2019
	*Laboa-Boundiali-Ferkessedougou (Côte d'Ivoire)	225	310	115	2019
	*Line Kayes (Mali)-Tambacounda (Senegal) (part of the Manantali II project of OMVS)	225	288	94	2020
	*Interconnection CLSG (Interconnection Côte d'Ivoire-Liberia-Sierra Leone-Guinea)	225	1303	517	2020
	*OMVG Loop (Senegal-The Gambia-Guinea Bissau-Guinea)	225	1677	722	2020
	*Manantali-Bamako line in Mali (part of the Manantali II project of the OMVS)	225	317	85	2021
	*Inteconnexion Guinea - Mali	225	1074	436	2021
	*Project North Core (interconnection Nigeria- Niger -Benin/Togo-Burkina)	330	832	541	2022
	*Kayes Line (Mali)-Kiffa (Mauritania) (part of the Manantali II project of the OMVS)	225	420	184	2022
	Second circuit of the CLSG interconnection to be commissioned in the same time as the first circuit	225	1303	131	2020
	Line Bolgatanga (Ghana)-Bobo (Burkina Faso)-Sikasso (Mali)	330	555	341	2022 Recommended
	TOTAL SHORT-TERM		8419 km	3288 MUSD	
Mid-term	*Line Manantali (Mali)-Boureya (Guinea)-Koukoutamba(Guinea)-Linsan (Guinea) (part of the Manantali II project of the OMVS)	225	462	166	2024
	*Line Buchanan (Liberia)-San Pedro (Côte d'Ivoire)	225	520	129	2028
	*Strengthening interconnection Côte d'Ivoire-Ghana	330	387	156	2029
	*Line Boundiali (Côte d'Ivoire)-Tengrela (Côte d'Ivoire)- Syama (Mali) - Bougouni (Mali)	225	330	96	2029

Final version

	Line	Level Voltage KV	Length [km]	Estimated cost [MUSD]	Date of commissioning
Long-term	Line Fomi (Guinea)-Boundiali (Côte d'Ivoire)	225	380	96	2025 Recommended
	Median Backbone (Nigeria-Benin-Togo-Ghana-Côte d'Ivoire)	330	1350	813	2025 Recommended
	Strengthening the coastal Backbone First Phase Nigeria-Benin 2nd Phase Benin-Togo-Ghana	330	400	281	First Phase: 2025 recommended Second Phase: 2028 recommended
	Line Labé- Koukoutamba In Guinea	225	115	50	2024 recommended
	Connection Segou Bamako	225	290	105	2025 recommended
	TOTAL MID-TERM		4234 km	1892 MUSD	
	Western Backbone (Senegal-The Gambia-Guinea-Bissau-Guinea-Mali) to reach Ghana-Burkina-Mali	330	1600	912	2033 Recommended
Long-term	Link Bobo (Burkina Faso)-Ferre (Côte d'Ivoire) to connect the Western Backbone to the Median	330	213	126	2033 Recommended
	Reinforcement of the Western section of the OMVG loop	225	800	301	2030 recommended
	Strengthening Niger-Nigeria Interconnection	330	510	332	2033 Recommended
	Second North-south axis in Ghana	330	750	426	2030 recommended
	Eastern Backbone in Nigeria	330	1856	966	2033
	Interconnection WAPP (Senegal/OMVS) - Northern Africa through Morocco		1250	615	2033
	Interconnection WAPP (Nigeria) - CAPP (Inga)		3300	1622	2033
	TOTAL LONG-TERM		10279 km	5300 MUSD	
GRAND TOTAL			22932 km	10480 MUSD	

* Decided Project

Final version

Transversal Actions

Transversal Actions

Support to the development of variable renewable energy projects at national level in ECOWAS Member States

Monitor the development of projects being developed by other sub-regional entities (OMVG, OMVS, NBA, CEB, MRU)

Pursue opportunities related to renewable energy deployment eg hybridization of hydropower and thermal power plants, floating photovoltaic technologies, deployment of storage technologies (including battery), and implement related projects should they be proven beneficial

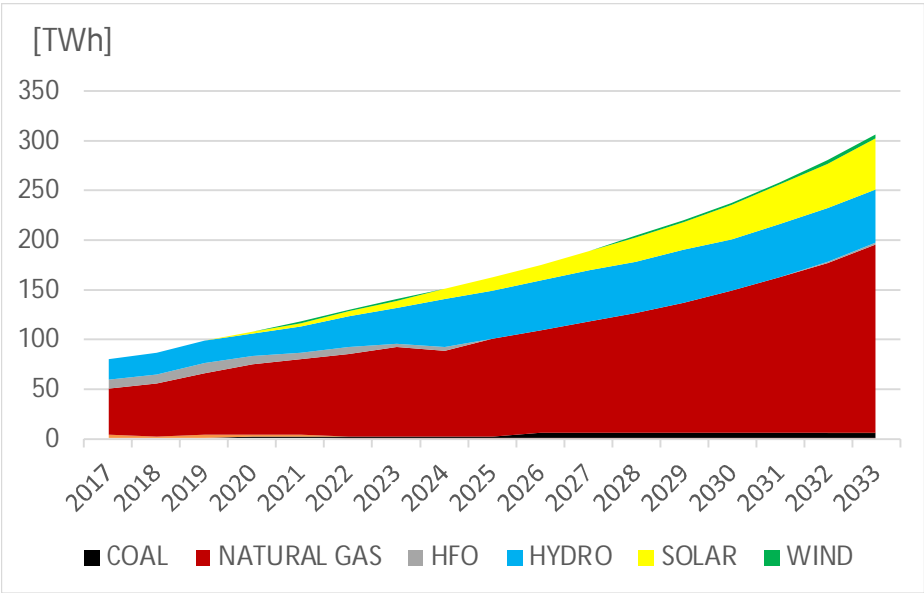
Deploy supplementary measures aimed at further consolidating the synchronism of the WAPP interconnected system

Support WAPP Member Utilities prepare and implement Action Plans aimed at improving their efficiency and performance

Develop a regional approach to address some of the challenges faced by the Distribution Utilities of the WAPP

Continue the capacity building/reinforcement of WAPP Member Utilities and accelerate the development of the WAPP Centers of Excellence

Optimal Evolution of the Energy Mix



Evolution of Energy Mix (TWh)

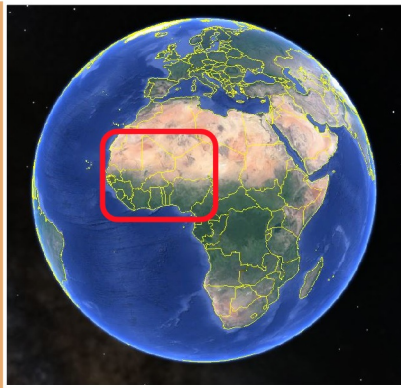
Map of the transmission Network

Final version



SYSTÈME D'ÉCHANGES D'ÉNERGIE ÉLECTRIQUE OUEST AFRICAIN

Réseaux électriques HT & projets d'interconnexion



WEST AFRICAN POWER POOL

HV Transmission network & interconnection projects

